

Spatial and temporal patterns of water temperature in streams and rivers of the Delaware River Basin

17 May 2020

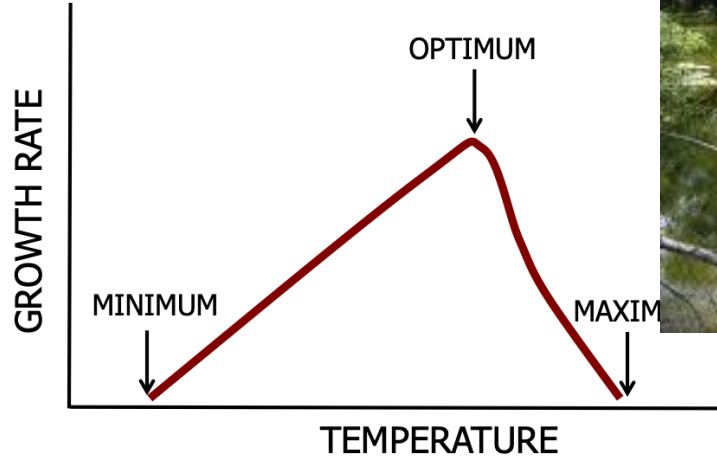
Master Watershed Stewards Sensor Station Support Workshop

Marc Peipoch, PhD
Assistant Research Scientist

A photograph of a small pond or stream. The water is dark and still, reflecting the surrounding environment. Several smooth, rounded stones of various shades of brown and grey are scattered throughout the scene. In the upper right corner, there is a large, dense patch of bright green moss growing on a rock. The overall atmosphere is calm and natural.

Why Temperature?

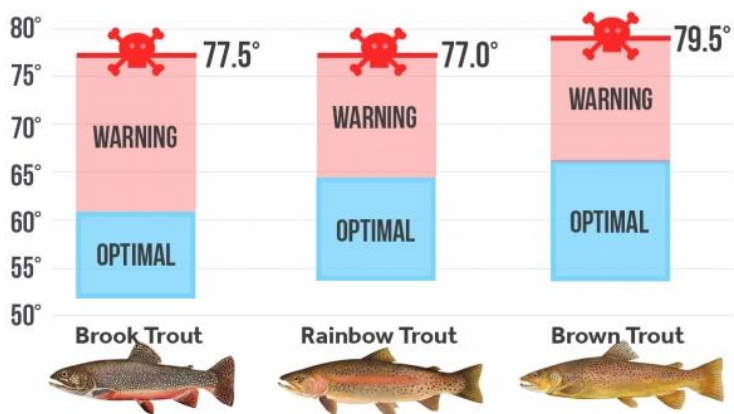
Temperature affects biological growth



Temperature controls fish presence

Warming Out of Range

Trout temperature zones



Source: Morrow, Jr. and Fischenich, 2000

CLIMATE CENTRAL



Muskellunge

55° to 73°



Northern Pike

55° to 75°



Walleye

53° to 72°



Crappie

65° to 75°



Bluegill

65° to 75°



Largemouth Bass

60° to 77°



Yellow Perch

55° to 72°



Rainbow Trout

50° to 65°



Lake Trout

42° to 55°



Coho (Silver) Salmon

44° to 60°



Brown Trout

52° to 73°



Brook Trout

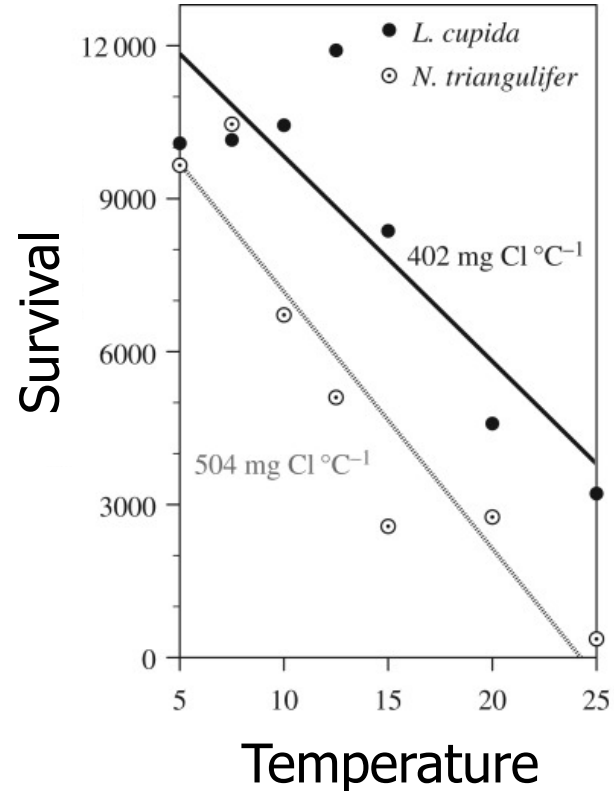
48° to 65°

Temperature affects toxicity

Temperature affects acute mayfly responses to elevated salinity: implications for toxicity of road de-icing salts

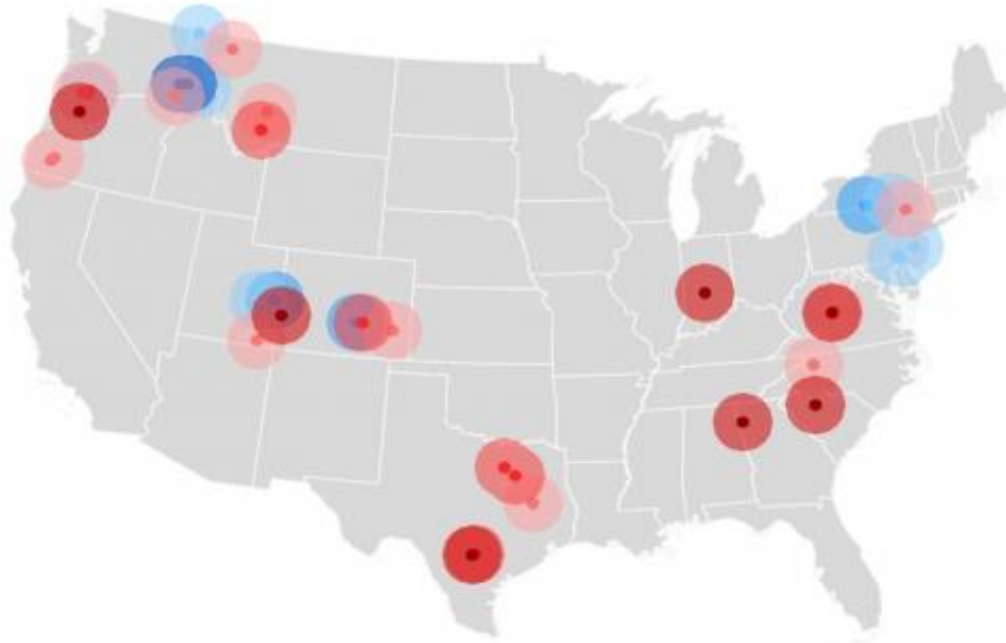
John K. Jackson and David H. Funk

Stroud Water Research Center, 970 Spencer Road, Avondale, PA 19311, USA



River & Stream Temperatures

Change in average temperature since 1990



Stream
temperatures are
rising at 65% of the
continental U.S.
gauges

Change in mean March–August temperature 1980–2018
Gauges chosen based on most consistent observational record
Source: USGS

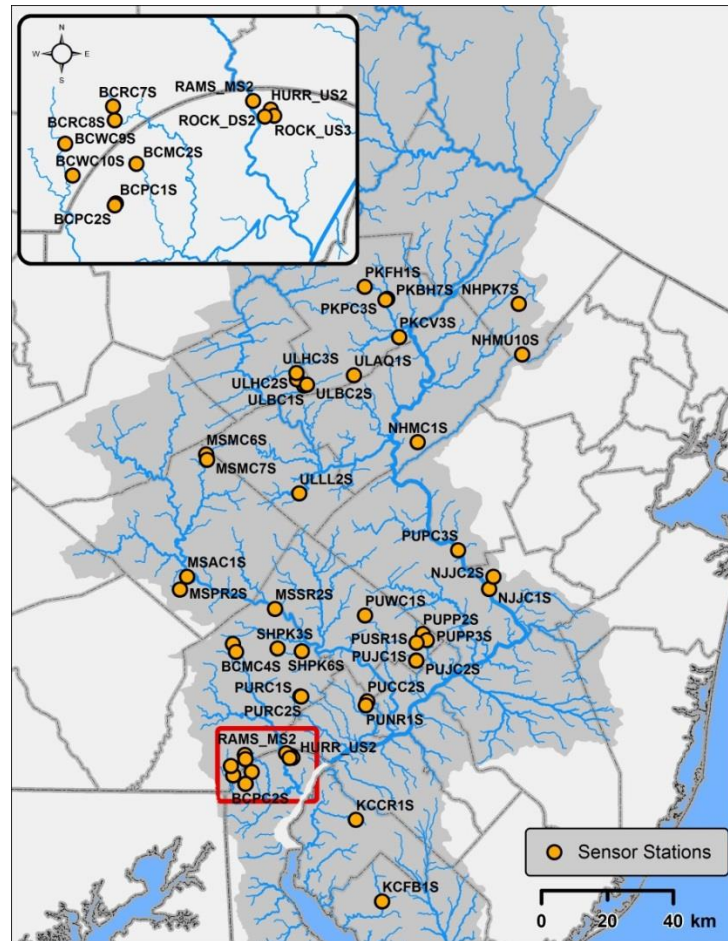


EnviroDIY sensor stations

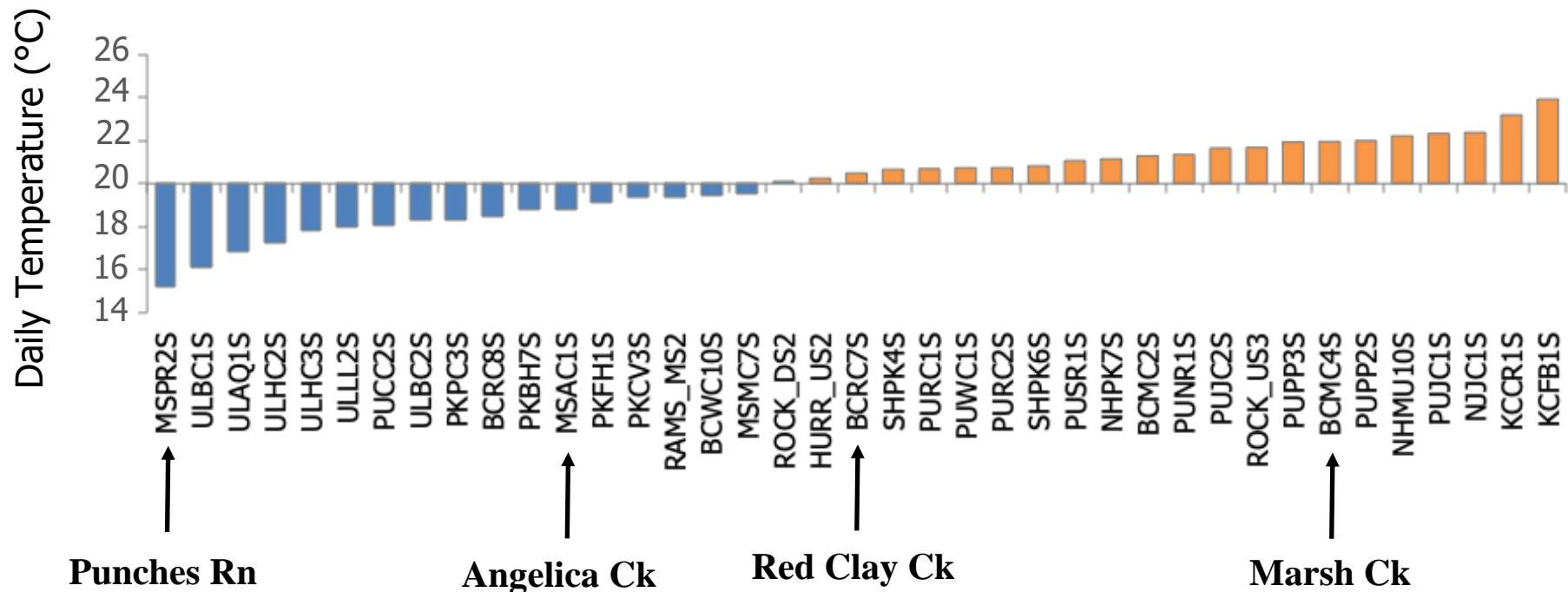
- Conductivity
- Water Temperature
- Depth
- Dissolved Oxygen

Data selection and screening

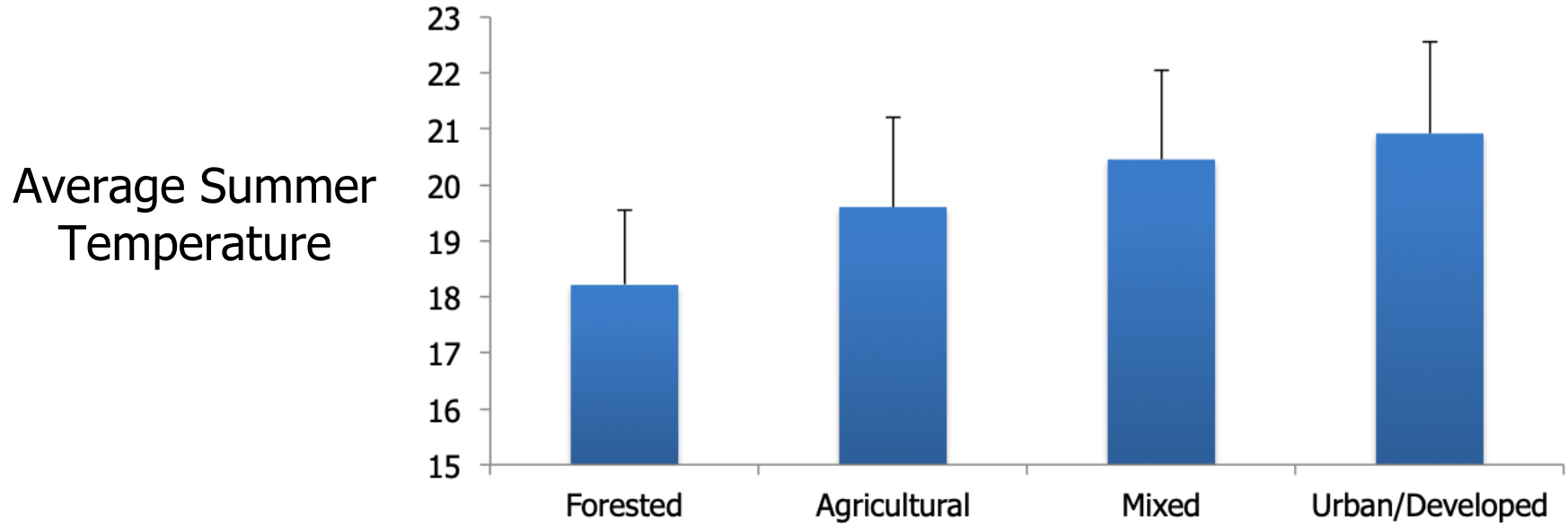
- DRWI Sensor Network
- Summer data (June-September)
- Data from 2017 and/or 2018
- 50 sites selected



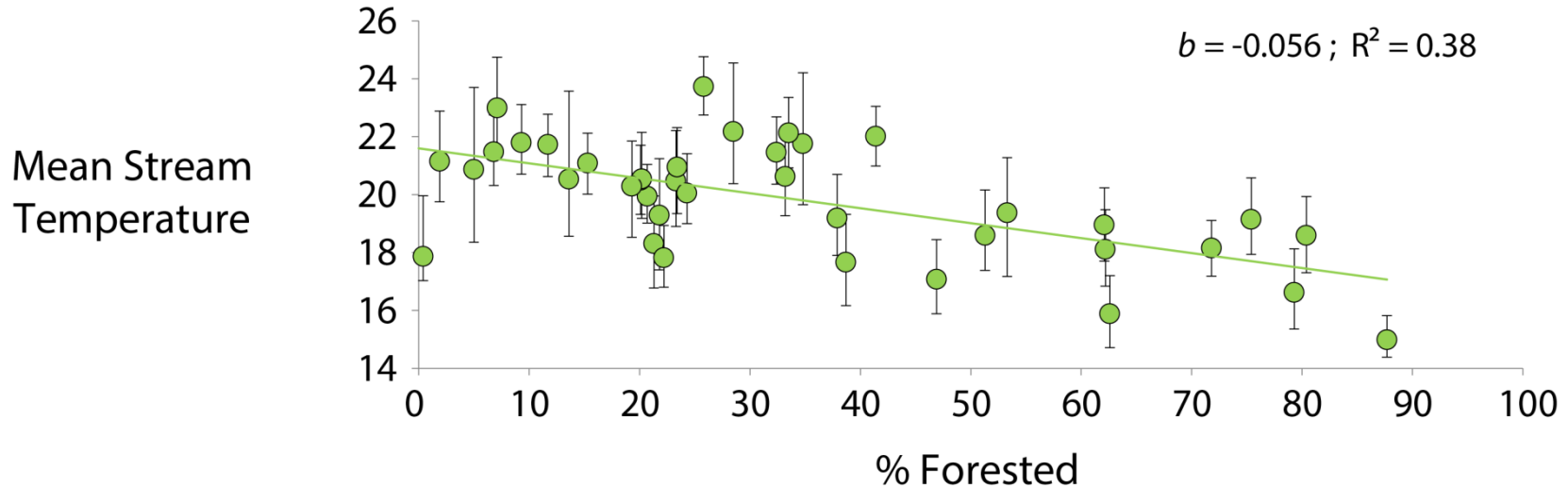
Summer Stream Temperature



Land use and stream temperature



Forest area and stream temperature



10% forested area yields a 0.5°C decrease

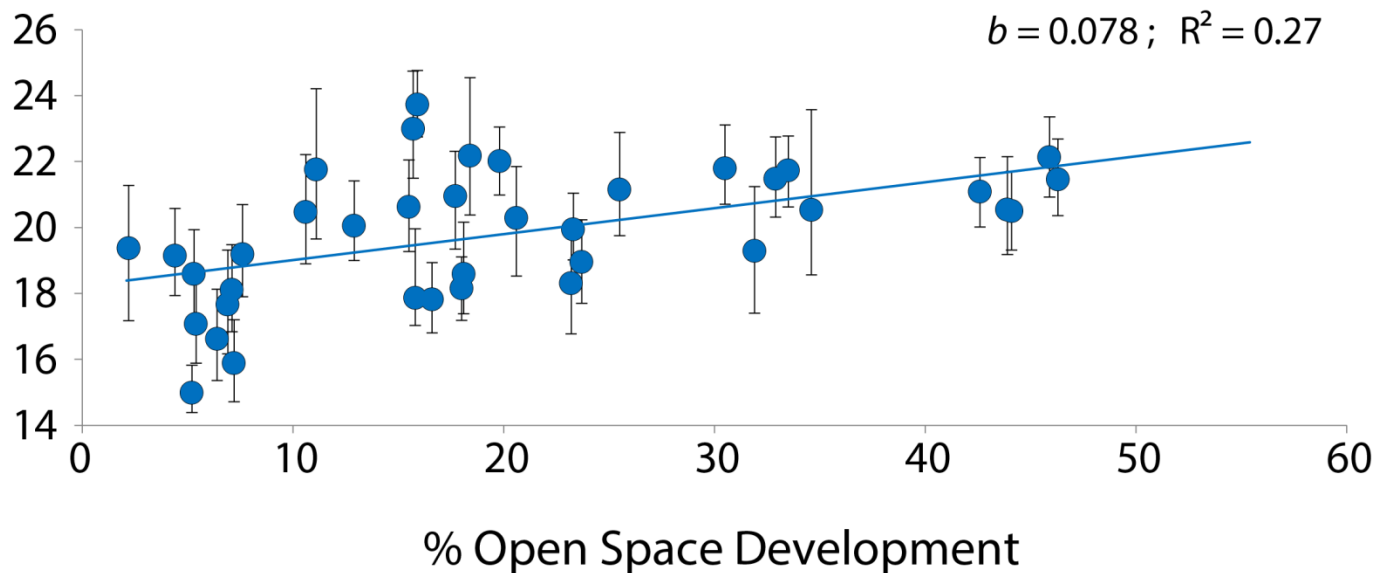
Urban Development and stream temperature

Open
development



% Urban or low, med, high
development intensity ($R^2 < 0.05$)

Mean Stream
Temperature





EnviroDIY sensor stations

Sentinels of thermal stress in cold-water fisheries

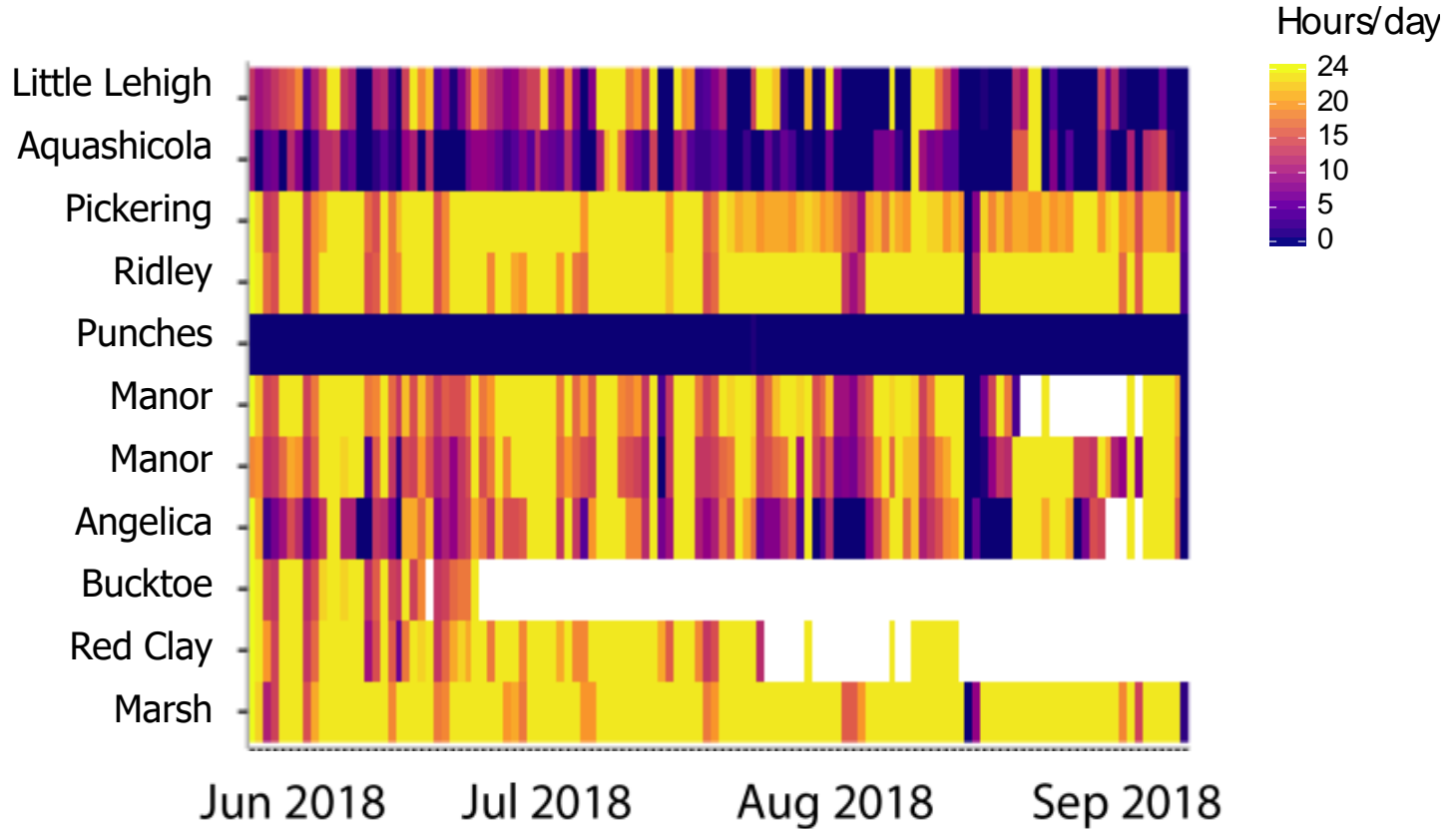
15.5°C – 18.8°C



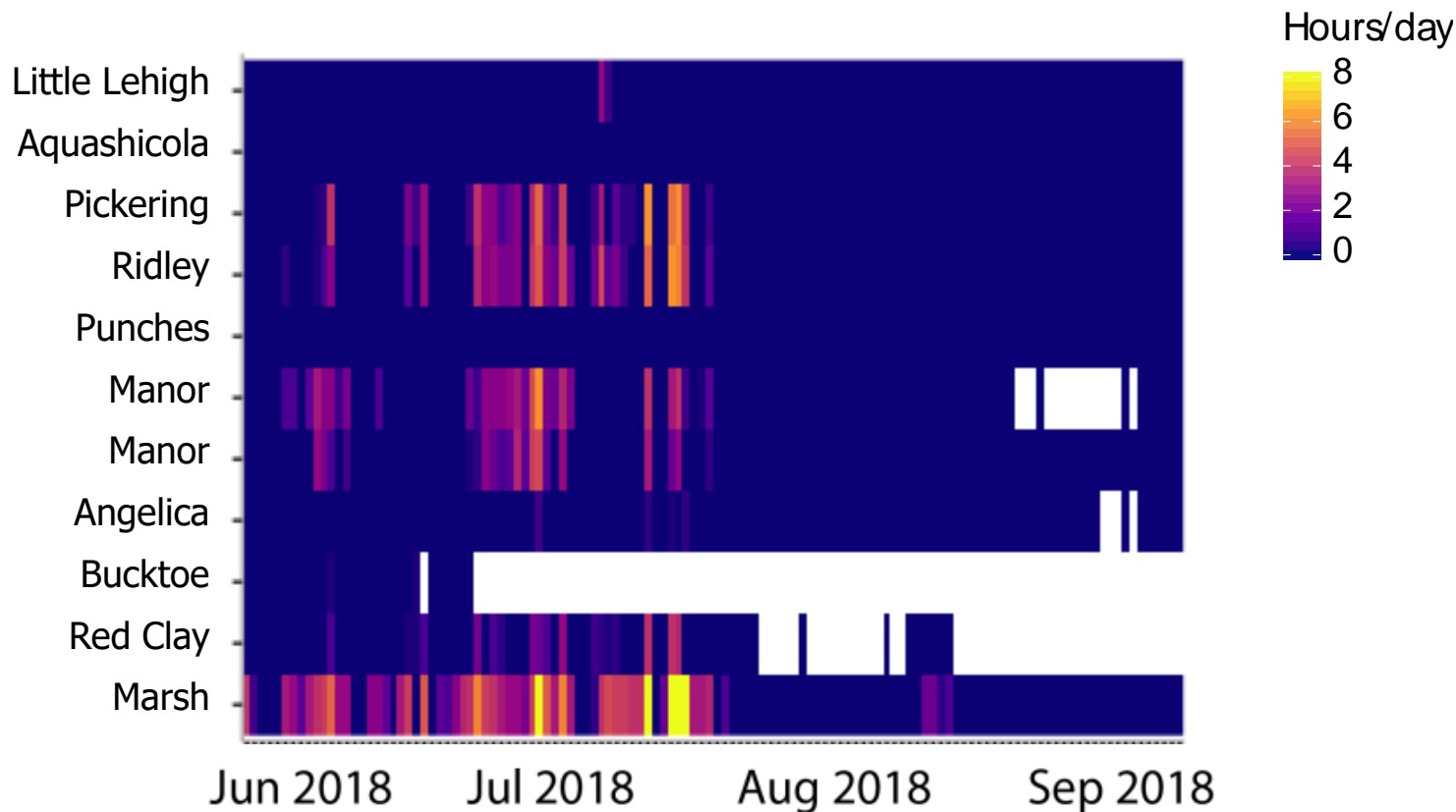
Guidance for trout stocking locations
21°C – 31°C



Hours/day exceeding Cold-Water Criteria



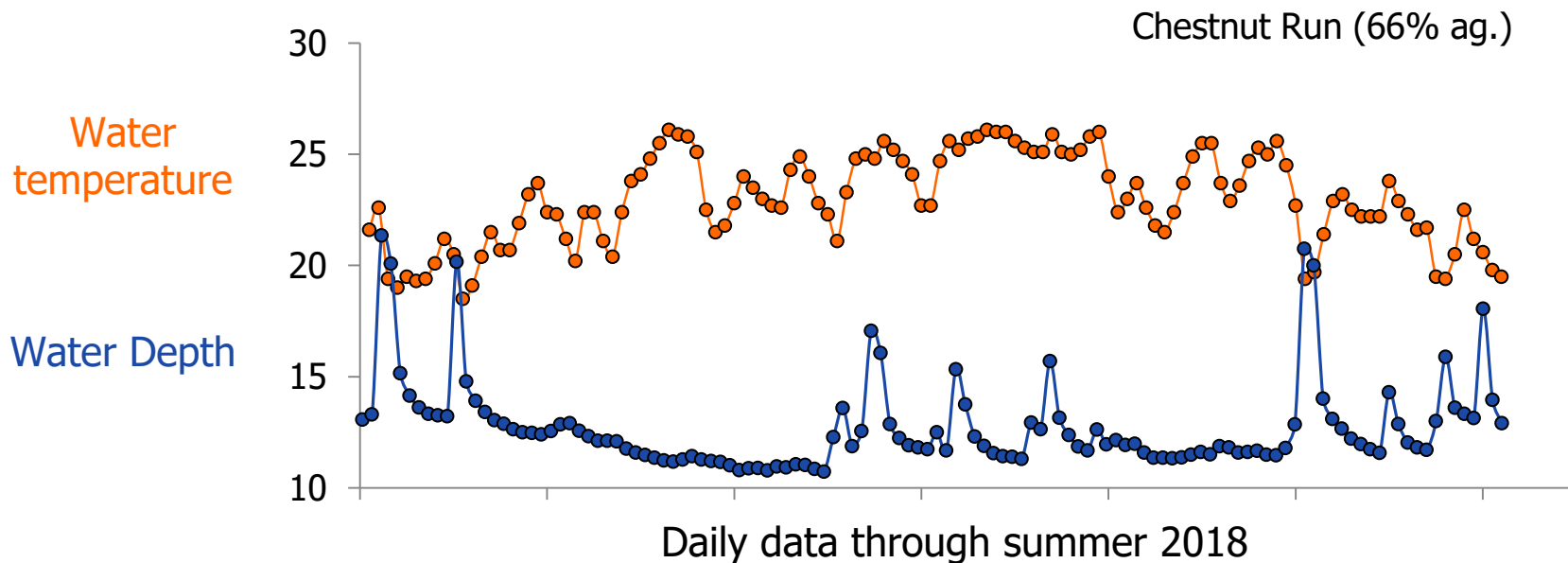
Hours/day exceeding Stocking Temperature Criteria



Temperature surges associated with storm events in contrasting watersheds

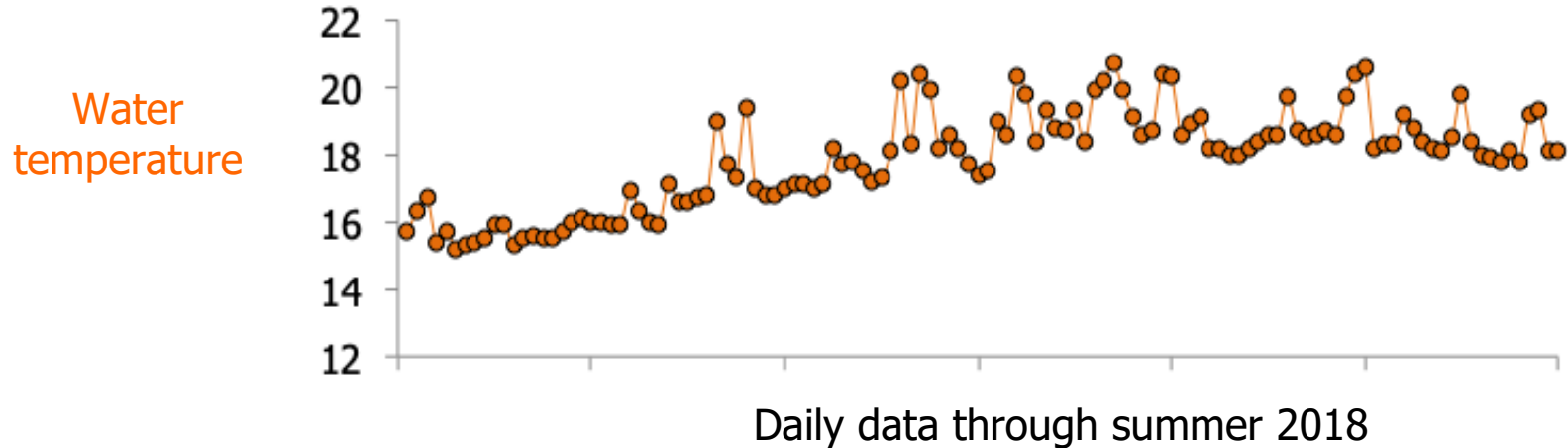
- A temperature surge was defined as an increase/decrease of $>1.3^{\circ}\text{C}$ over 15 minutes
- Assumed to persist until temperatures had reached $\leq 1.3^{\circ}\text{C}$ of the pre-surge temperature

No evidence of temperature surge in most forested and agricultural streams



Decreases in Temperature during Storm Flow

A total of 33 temperature surges registered in Cobbs Creek (88% urban watershed)



Increases in Temperature during Storm Flow

In summary

- Significant 'cooling effects' of forested watersheds on stream temperatures at the large scale
- Exceedance of state criteria for Cold Water Fish by many hours/days in multiple streams
- Contrasting patterns of stormflow on stream temperatures depending on land use

Acknowledgments

- Citizen scientists
- Collaborators:
 - Diana Oviedo-Vargas
 - John Jackson
 - David Bressler
 - David Arscott
 - Charlie Dow



William Penn
W I L L I A M P E N N
F O U N D A T I O N

STROUDTM
WATER RESEARCH CENTER
www.stroudcenter.org